Contents

PART A

Preface vii

OPENING LECTURE

STM: 10 years after
H. Rohrer 1

PLENARY LECTURES

Force microscopy
G. Binnig 7

Atomic-scale tip–sample interactions and contact phenomena
S. Ciraci 16

On the observability of Coulomb blockade and single-electron tunneling
M.H. Devoret, D. Esteve, H. Grabert, G.-L. Ingold, H. Pothier and C. Urbina 22

Edge melting of the Ge(111) surface studied by scanning tunneling microscopy
R.M. Feenstra, A.J. Slavin, G.A. Held and M.A. Lutz 33

Molecules at interfaces: STM in materials and life sciences
J.P. Rabe 41

The following plenary lectures were presented but are not included in these proceedings

Some theoretical issues in STM related to tip/sample electronic structure
N.D. Lang

The scanning tunneling microscope in metrology
E.C. Teague

Manipulation and modification
C.F. Quate

STM of superconductivity
H. Hess

THEORY/PHYSICS OF TIPS/TIP–SAMPLE INTERACTIONS

Theoretical modelling of AFM for bimetallic tip–substrate interactions
G. Bozzolo and J. Ferrante 55

Intermolecular and surface forces in noncontact scanning force microscopy
U. Hartmann 59

An evaluation of the use of the atomic force microscope for studies in nanomechanics
S.R. Cohen 66

Interaction forces between a tungsten tip and methylated SiO_2 surfaces studied with scanning force microscopy
L. Olsson, P. Tengvall, R. Wigren and R. Erlandsson 73

Vu Thien Binh and N. García 80

Electronic structure of transition metal tips and tip–surface interactions
F. Gautier, H. Ness and D. Stoeffler 91

Influence of STM tip on electronic structure: Si(100) dimers
Z.-H. Huang and R.E. Allen 97

First-principles calculation of STM images of the Si(111)$\sqrt{3} \times \sqrt{3}$-Ag surface
S. Watanabe, M. Aono and M. Tsukada 105

First-principles simulation of STM/STS of Si(100) reconstructed surfaces
N. Isshiki, H. Kageshima, K. Kobayashi and M. Tsukada 109

Are electronic interference effects important for STM imaging of substrates and adsorbates? A theoretical analysis
P. Sautet and C. Joachim 115

Theoretical framework for the interpretation of STM images of adsorbates
V.M. Kenkre, F. Biscarini and C. Bustamante 122

Manipulating atoms and molecules with a scanning tunneling microscope
P. Zeppenfeld, C.P. Lutz and D.M. Eigler 128

Large enhancement of transmission probability in non-equilibrium time evolution quantum mechanics
R. Casero, P.A. Serena and N. García 134

Investigation of the tunneling current for adsorbates on a surface
W. Sacks and C. Noguera 140

In-situ characterization of tip electronic structure in scanning tunneling microscopy
C.J. Chen 147

3D calculations at atomic scale of the electrostatic potential and field created by a teton tip
D. Atlan, G. Gardet, Vu Thien Binh, N. García and J.J. Sáenz 154

Adhesive energy, force and barrier height between simple metal surfaces
S. Ciraci, E. Tekman, M. Gökçedag, I.P. Batra and A. Baratoff 163

The whip motion of ultra-thin tunneling tips
W. Hanrieder, R. Mock and H. Meixner 169

On the transition from tunneling regime to point-contact: graphite
N. Agraït, J.G. Rodrigo and S. Vieira 177

Micro-tribological evaluations of a polymer surface by atomic force microscopes
E. Hamada and R. Kaneko 184

Theoretical treatment of mediated electron transfer in strong electric fields
W. Gründler 191

Model calculation for spin-polarized tunneling
D. Bürgler and G. Tarrach 194

Simple model for the topographic imaging process in a scanning tunneling microscope
M. Hietschold and H. Sbosny 200

Electronic structure of small lithium–ammonia clusters
W. Gründler and N.H. Thong 206

Low-temperature luminescence due to minority carrier injection from the scanning tunneling microscope tip
L. Montelius, M.-E. Pistol and L. Samuelson 210

Inelastic processes in tunnelling electrodes
M.E. Taylor 215

On the dynamics of statistical fluctuations in the electron tunneling process and the problems of STM resolution
N.A. Tarasov 223

Tunneling through a deformed potential
W. Mizutani, M. Shigeno, K. Kajimura and M. Ono 236

Theory of photovoltaic effect in STM: application to graphite
A. Levy Yeyati and F. Flores 242

Three-dimensional scattering and scanning tunneling microscope images
J.P. Vigneron, I. Derycke, Ph. Lambin, Th. Laloyaux, A.A. Lucas, L. Libioulle and A. Ronda 250

FORCE MICROSCOPY

Generation and imaging of domains with the magnetic force microscope
T. Göddenhenrich, U. Hartmann and C. Heiden 256

Large-scale charge storage by scanning capacitance microscopy
R.C. Barrett and C.F. Quate 262

Surface investigations with a Kelvin probe force microscope
M. Nonnenmacher, M. O'Boyle and H.K. Wickramasinghe 268

Structure and dynamics of solid surfaces observed by atomic force microscopy
E. Meyer, L. Howald, R. Overney, D. Brodbeck, R. Lüthi, H. Haefke, J. Frommer and H.-J. Güntherodt 274

Investigation of the (001) cleavage plane of potassium bromide with an atomic force microscope at 4.2 K in ultra-high vacuum
F.J. Giessibl and G. Binnig 281

Atomic surface and lattice structures of AgBr thin films
H. Haefke, E. Meyer, L. Howald, U. Schwarz, G. Gerth and M. Krohn 290

Modelling of impurity dopant density measurement in semiconductors by scanning force microscopy
Y.J. Huang, J. Slinkman and C.C. Williams 298

Atomic force and scanning tunneling microscopy of comb-like cholesteric liquid crystalline polymer LB films
Yu. Moiseev, V. Panov, S. Savinov, I. Yaminsky, P. Todua and D. Znamensky 304

Atomic force microscope detection system using an optical fiber heterodyne interferometer free from external disturbances
T. Oshio, N. Nakatani, Y. Sakai, N. Suzuki and T. Kataoka 310

Magnetic-force-sensing STM: novel application of STM for simultaneous measurement of topography and field gradient of magnetic recording heads
O. Watanuki, F. Sai and K. Sueoka 315

High-frequency circuit characterization using the AFM as a reactive near-field probe
G.E. Bridges and D.J. Thomson 321

Scanning force microscopy of diatom shells
A. Linder, J. Colchero, H.-J. Apell, O. Marti and J. Mlynek 329

SPECIAL EFFECTS AND RELATED TECHNIQUES

STM control of non-integer charge on a metal particle inferred from Coulomb staircase
Z.Y. Rong, A. Chang, L.F. Cohen and E.L. Wolf 333

Recent advances in spin-polarized scanning tunneling microscopy
R. Wiesendanger, I.V. Shvets, D. Bürgler, G. Tarrach, H.-J. Güntherodt and J.M.D. Coey 338

Mechanical and thermal effects of laser irradiation on force microscope cantilevers
O. Marti, A. Ruf, M. Hipp, H. Bielefeldt, J. Colchero and J. Mlynek 345

Optical absorption spectroscopy by scanning force microscopy
M. Nonnenmacher and H.K. Wickramasinghe 351

Enhanced photon emission from the STM: a general property of metal surfaces
R. Berndt, J.K. Gimzewski and R.R. Schlittler 355

Observation of local photoemission using a scanning tunneling microscope
J.K. Gimzewski, R. Berndt and R.R. Schlittler 366

Laser thermal effects on atomic force microscope cantilevers
M. Allegrini, C. Ascoli, P. Baschieri, F. Dinelli, C. Frediani, A. Lio and T. Mariani 371

Scanning tunneling microscopy at microwave frequencies
W. Seifert, E. Gerner, M. Stachel and K. Dransfeld 379

High-frequency surface-displacement detection using an STM as a mixer–demodulator
K.J. Strozewski, S.E. McBride and G.C. Wetsel, Jr. 388

The concept of a coaxial tip as a probe for scanning near field optical microscopy and steps towards a realisation
U.Ch. Fischer and M. Zapletal 393

Superresolution optical imaging with a high-brightness subwavelength light source
K. Lieberman and A. Lewis 399

Progress in photon scanning tunneling microscopy
T.L. Ferrell, S.L. Sharp and R.J. Warmack 408

Evanescent-field optical microscopy: effects of polarization, tip shape and radiative waves
N.F. van Hulst, F.B. Segerink, F. Achten and B. Bölger 416

Resolution of the photon scanning tunneling microscope: influence of physical parameters
F. de Fornel, L. Salomon, P. Adam, E. Bourillot, J.P. Goudonnet and M. Nevière 422

Self-consistent study of the electromagnetic coupling between a thin probe tip and a surface: implication for atomic-force and near-field microscopy
X. Bouju, C. Girard and B. Labani 430

ELECTROCHEMISTRY

AFM study of the structure of underpotentially deposited Ag and Hg on Au(111)
C.-H. Chen and A.A. Gewirth 437

In situ scanning tunneling microscopy of underpotential deposition in aqueous solution. III. Silver adlayers on Au(111)
T. Hachiya and K. Itaya 445

STM observations of two-dimensional condensed layers on solid electrodes
R. Srinivasan, J.C. Murphy and N. Pattabiraman 453

A new electrochemical scanning tunneling microscope
Z.W. Tian, X.D. Zhuo, J.Q. Mu, J.H. Ye, Z.D. Fen, B.W. Mao, C.L. Bai and C.D. Dai 460

A new method of STM tip fabrication for in-situ electrochemical studies
B.W. Mao, J.H. Ye, X.D. Zhuo, J.Q. Mu, Z.D. Fen and Z.W. Tian 464

Fluorescent micropattern formation on ionic conductive polymer films by a scanning electrochemical microscope
H. Sugimura, T. Uchida, N. Shimo, N. Kitamura and H. Masuhara 468

METALS

A comparative STM study of the growth of thin Au films on clean and oxygen-precovered Ru(0001) surfaces
J. Schröder, C. Günther, R.Q. Hwang and R.J. Behm 475

In situ observation of epitaxial growth of Co thin films on Cu(100)
A.K. Schmid and J. Kirschner 483

Tip-dependent contrast in STM imaging of adsorbed sulfur layers: theory and experiment
J.C. Dunphy, D.F. Ogletree, M.B. Salmeron, P. Sautet, M.-L. Bocquet and C. Joachim 490

Oxygen-induced restructuring of Ni(110) studied by scanning tunneling microscopy
L. Eierdal, F. Besenbacher, E. Lægsgaard and I. Stensgaard 505

On the shape of monatomic steps of copper surface in STM images
F. Thibaudau and J. Cousty 511

Step–step interactions on copper vicinal surfaces
S. Rousset, S. Gauthier, O. Siboulet, J.C. Girard, S. de Cheveigné, M. Huerta-Garnica, W. Sacks, M. Belin and J. Klein 515

STM investigation of gallium single-crystal surfaces close to bulk melting
O. Züger and U. Dürig 520

Tunneling characteristics at atomic resolution on close-packed metal surfaces
R. Berndt, J.K. Gimzewski and R.R. Schlittler 528

Distance dependence and corrugation in barrier-height measurements on metal surfaces
R. Schuster, J.V. Barth, J. Wintterlin, R.J. Behm and G. Ertl 533

Carbidic and graphitic carbon on Ni(771): aspects for catalysis
O. Haase, R. Koch, M. Borbonus and K.H. Rieder 541

Field emission resonances studied with $dI/ds(V)$ and $dI/dV(V)$ curves
L. Scandella and H.-J. Güntherodt 546

Oxygen adsorption on Ag(110) studied by the FI-STM
T. Hashizume, M. Taniguchi, K. Motai, H. Lu, K. Tanaka and T. Sakurai 553

Nucleation and growth of Fe on Cu(111) in the monolayer range
A. Brodde and H. Neddermeyer 556

Polymorphism of iodine adlattices on Pt(100)
R. Vogel and H. Baltruschat 562

Scanning tunneling microscopy of oxidized titanium surfaces in air
H. Olin, B.-O. Aronsson, B. Kasemo, J. Lausmaa and M. Rodahl 567

Scanning tunneling microscopy and X-ray reflectometry of Pt and Pd thin films prepared by DC sputtering
O. Enea, M. Rafai and A. Naudon 572

Atomic force and scanning tunneling microscopy observations of whisker crystals and surface modification on evaporated gold films
P.I. Oden, L.A. Nagahara, J.J. Graham, J. Pan, N.J. Tao, Y. Li, T.G. Thundat, J.A. DeRose and S.M. Lindsay 580

Temporal behaviour of nanofeatures on Au
H.P. Hagan, P.A. Campbell, K.W. Smith, R.J. Turner and D.G. Walmsley 587

Scanning tunneling microscopy of nanostructured palladium
G.H. Wang, H. Fuchs, R. Laschinski, R. Sander, R. Birringer and H. Gleiter 594

OTHER MATERIALS/SUPERCONDUCTORS

In-situ observation of 1T-$TaS_{2-x}Se_x$ charge density waves
K. Sakamaki, A. Fujishima and Y. Onuki 599

Buckyball–substrate interactions probed by STM and AFM
D. Sarid, T. Chen, S. Howells, M. Gallagher, L. Yi, D.L. Lichtenberger, K.W. Nebesney, C.D. Ray, D.R. Huffman and L.D. Lamb 610

Scanning tunneling microscopy observation of the initial stages of growth of carbon films grown by pulsed laser vaporization of graphite
L. Vazquez, J.A. Martin-Gago, F. Comin and S. Ferrer 616

Scanning tunneling microscopy study of ternary alkali-metal graphite intercalation compounds
H.P. Lang, V. Thommen-Geiser and R. Wiesendanger 624

Scanning tunneling microscopy of single-layer MoS_2 in water and butanol
X.R. Qin, D. Yang, R.F. Frindt and J.C. Irwin 630

Atomic-scale imaging of anisotropic organic conductors by scanning probe techniques (STM/AFM)
G. Bar, S.N. Magonov, H.-J. Cantow, J. Gmeiner and M. Schwoerer 644

Scanning tunneling microscopy of the damage induced by ion bombardment on a graphite surface
R. Coratger, A. Chahboun, V. Sivel, F. Ajustron and J. Beauvillain 653

Topochemistry of graphite oxidation
F. Atamny, R. Schlögl, W.J. Wirth and J. Stephan 660

Scanning-tunneling-microscopy-enhanced oxidation of uranium deposited on the basal plane of graphite
R.J. Tench, M. Balooch, W.J. Siekhaus and W. McLean II 668

Atomic-resolution images of structural defects on microcrystalline graphite
T. Endo, H. Yamada, T. Sumomogi, K. Kuwahara, S. Morita and T. Kino 674

STM study of $CuCl_2$ intercalated in graphite
R.A. Pappas, E.R. Hunt and S.E. Ulloa 679

Atomically resolved STM imaging of ion-bombarded WSe_2
Th. Schimmel, H. Fuchs, R. Sander and M. Lux-Steiner 683

Localised structure of homoepitaxial diamond
H.G. Maguire, M. Kamo, H.P. Lang and H.-J. Güntherodt 689

Influence of a transport current on the Abrikosov flux lattice observed with a low-temperature scanning tunneling microscope
R. Berthe, U. Hartmann and C. Heiden 696

Scanning tunneling spectroscopy of the Abrikosov flux lattice from the clean toward the dirty limit
Ch. Renner, A.D. Kent, Ph. Niedermann, Ø. Fischer and F. Lévy 699

The effect of sputter deposition conditions on growth mechanism and microstructure of $YBa_2Cu_3O_{7-x}$ thin films on $NdGaO_3$ substrates studied by scanning tunneling microscopy
M.E. Hawley, I.D. Raistrick, R.J. Houlton, F.H. Garzon and M. Piza 705

Atomic resolution of single-crystalline $Y_2Ba_4Cu_{6+n}O_{14+n}$ ($n = 0, 1, 2$) and laser-ablated thin film $Y_1Ba_2Cu_3O_7$ HT_cSC by STM
H.P. Lang, J.P. Ramseyer, D. Brodbeck, T. Frey, J. Karpinski, E. Kaldis and Th. Wolf 715

Scanning tunneling microscopy of surface properties of epitaxial $YBa_2Cu_3O_{7-\delta}$ and $Bi_2Sr_2Ca_1Cu_2O_{8+\delta}$ high-T_c thin films prepared by different methods
J. Burger, P. Bauer, M. Veith and G. Saemann-Ischenko 721

Studies of the surface structure of $YBa_2Cu_3O_7$ thin films using STM
I. Maggio-Aprile, A.D. Kent, Ph. Niedermann, Ch. Renner, L. Antognazza, L. Miéville, O. Brunner, J.-M. Triscone and Ø. Fischer 728

Scanning tunneling microscopy of laser-deposited YBCO thin films
H. Olin, G. Brorsson, P. Davidsson, Z.G. Ivanov, P.-Å. Nilsson and T. Claeson 734

Scanning tunneling microscopy of Bi–O surfaces of Bi2212 superconductors
K. Ikeda, K. Takamuku, K. Yamaguchi, R. Itti, N. Koshizuka and S. Tanaka 738

STM study of transition-metal oxide
T. Oshio, Y. Sakai, T. Moriya and S. Ehara 744

A STM/STS and XPS study of oxidized metal powders
B.A. Kwetkus and K. Sattler 749

Magnetic force microscopy investigation of superconductors: first results
A.P. Volodin and M.V. Marchevsky 757

SEMICONDUCTORS

Nanoscale photovoltaic imaging using the scanning tunneling microscope
O.J. Glembocki, E.S. Snow, C.R.K. Marrian, S.M. Prokes and D.S. Katzer 764

Dislocation reaction on p-doped GaAs (011) observed by scanning tunnelling microscopy
G. Cox, Ph. Ebert, U. Poppe, M. Simon and K. Urban 776

Interfacial dislocations detected by scanning tunneling microscopy
R. Stalder, H. Sirringhaus, N. Onda and H. von Känel 781

Measurement of space charge adjacent to oxide grain boundaries by tunneling spectroscopy
D.A. Bonnell and I. Solomon 788

Dimer switching on Si(100)
J. Gryko and R.E. Allen 793

Quantitative voltage-dependent STM image simulations for semiconductors
J.H. Wilson, D.A. McInnes, J. Knall, A.P. Sutton and J.B. Pethica 801

Dynamic polarization effects and tunneling time
P. Guéret 809

Real-time observation of step motion on Si(111) surface by scanning tunneling microscopy
H. Tokumoto, K. Miki, Y. Morita, T. Sato, M. Iwatsuki, M. Suzuki and T. Fukuda 816

Real-time STM investigation of the initial stages of oxygen interaction with Si(100)2×1
R. Kliese, B. Röttger, D. Badt and H. Neddermeyer 824

Layer-by-layer growth of germanium on Si(100): strain-induced morphology and the influence of surfactants
U. Köhler, O. Jusko, B. Müller, M. Horn-von Hoegen and M. Pook 832

STM studies of Si(100)-2×1 oxidation: defect chemistry and Si ejection
Ph. Avouris and D. Cahill 838

A new metastable epitaxial silicide: $FeSi_2$/Si(111)
A.L. Vazquez de Parga, J. de la Figuera, C. Ocal and R. Miranda 845

Real-time observation of the Si(111):(7×7)–(1×1) phase transition by scanning tunneling microscopy
K. Miki, Y. Morita, H. Tokumoto, T. Sato, M. Iwatsuki, M. Suzuki and T. Fukuda 851

Observation of indium on GaAs(110) surfaces by scanning tunneling microscopy
M. Suzuki and T. Fukuda 858

Si(111)7×7 domain boundaries on vicinal surfaces
H. Tanaka, M. Udagawa, M. Itoh, T. Uchiyama, Y. Watanabe, T. Yokotsuka and I. Sumita 864

A STM study of the InP (110) surface
Ph. Ebert, G. Cox, U. Poppe and K. Urban 871

Local tunneling spectroscopy of n-PbTe surface
D.N. Davydov, A.O. Golubok and S.A. Rykov 878

Chemisorption and kinetics of Sb on Si(001)
H.B. Elswijk and E.J. van Loenen 884

Adsorption site of alkali metal overlayers on Si(001)2×1
I.P. Batra and S. Ciraci 889

STM study of geometric and electronic structures of Ge dimers on Si(001)
F. Iwawaki, H. Kato, M. Tomitori and O. Nishikawa 895

STM study of initial stage of Ge epitaxy on Si(001)
F. Iwawaki, M. Tomitori and O. Nishikawa 902

Homo-epitaxial growth on the Si(111)7×7 surface
A. Ichimiya, T. Hashizume, K. Ishiyama, K. Motai and T. Sakurai 910

FI-STM investigation of the Si(111)2×1 cleaved surface
Y. Mera, T. Hashizume, K. Maeda and T. Sakurai 915

Scanning tunneling microscopy of 1%-HF-treated Si(111) surfaces
Y. Morita, K. Miki and H. Tokumoto 922

Current imaging tunneling spectroscopy of metallic deposits on silicon
A. Asenjo, J.M. Gómez-Rodríguez and A.M. Baró 933

Observation of step formation on vicinal Si(111) surfaces by atomic force microscopy
M. Suzuki, Y. Homma, Y. Kudoh and R. Kaneko 940

The initial stages of the oxidation of Si(100)2 × 1 studied by STM
M. Udagawa, Y. Umetani, H. Tanaka, M. Itoh, T. Uchiyama, Y. Watanabe, T. Yokotsuka and I. Sumita 946

Ge(111)/Ga: a two-dimensional, domain-type superlattice
J. Zegenhagen and P. Molinàs-Mata 952

An investigation of the early stages of native oxide growth on chemically etched and sulfur-treated GaAs(100) and InP(100) surfaces by scanning tunnelling microscopy
P. Moriarty and G. Hughes 956

PART B

ORGANICS

Molecular position at the liquid/solid interface measured by voltage-dependent imaging with the STM
K. Yackoboski, Y.H. Yeo, G.C. McGonical and D.J. Thomson 963

An AFM with integrated micro-fluorescence optics: design and performance
M. Radmacher, K. Eberle and H.E. Gaub 968

Surface manipulation on layered organic crystals by scanning force microscopy
D. Bosbach and W. Rammensee 973

Surface modification of organic films deposited on graphite by the scanning tunneling microscope
M.O. Bashkin, V.A. Bespalov, A.V. Emelyanov, V.N. Inkin, S.M. Portnov, A.V. Zimin, S.I. Kharkevich and O.D. Menshikov 977

Molecular surface structure of organic crystals observed by atomic force microscopy
R.M. Overney, L. Howald, J. Frommer, E. Meyer, D. Brodbeck and H.-J. Güntherodt 983

Investigating poly(1-butene) films by SFM/STM
L.M. Eng, H. Fuchs, K.D. Jandt and J. Petermann 989

Scanning probe microscopy studies of isotactic polypropylene
G.W. Zajac, M.Q. Patterson, P.M. Burrell and C. Metaxas 998

Schottky-barrier formation in conducting polymers
F.G.C. Hoogenraad, A.C.R. Hogervorst, P.M.L.O. Scholte and F. Tuinstra 1004

Surface analysis of organic superconductors by scanning probe techniques: STM and AFM
S.N. Magonov, G. Bar, E. Keller, E.B. Yagubskii, E.E. Laukhina and H.-J. Cantow 1009

Bilipid layer molecular organization in P_β phase studied by scanning tunneling microscopy
C.H. Obcemea and B. Vidic 1019

Scanning tunneling microscopy studies of alanine and phenylalanine molecules adsorbed on graphite
J. Mou and W.S. Yang 1025

Atomic charge superposition calculations of STM images of glycine and alanine adsorbed on graphite
W.S. Yang, Y. Li, J. Mou and J. Yan 1031

STM of conducting polymer thin films formed by electropolymerization on graphite and gold
E. Lacaze, J. Garbarz, V. Quillet, M. Schott, M.C. Pham, J. Moslih and P.C. Lacaze 1037

Imaging of organic molecular films with the atomic force microscope
H. Yamada, S. Akamine and C.F. Quate 1044

Analysis of adenine and thymine adsorbed on graphite by scanning tunneling and atomic force microscopy
M.J. Allen, M. Balooch, S. Subbiah, R.J. Tench, R. Balhorn and W. Siekhaus 1049

Ordering of didodecylbenzene on graphite: a combined SFM/STM study
L.M. Eng, H. Fuchs, S. Buchholz and J.P. Rabe 1059

Barrier-height imaging of fatty acid Langmuir–Blodgett films
E. Kishi, H. Matsuda, R. Kuroda, K. Takimoto, A. Yamano, K. Eguchi, K. Hatanaka and T. Nakagiri 1067

BIOLOGY

Domain walls on graphite mimic DNA
W.M. Heckl and G. Binnig 1073

Scanning tunneling microscopic imaging of doped polyaniline
C. Bai, C. Zhu, G. Huang, J. Yang, M. Wan and R.-S. Chen 1079

Electrostatic spraying of DNA molecules for investigation by scanning tunneling microscopy
T. Thundat, R.J. Warmack, D.P. Allison and T.L. Ferrell 1083

Scanning tunneling microscopy of DNA: a novel technique using radiolabeled DNA to evaluate chemically mediated attachment of DNA to surfaces
D.P. Allison, R.J. Warmack, L.A. Bottomley, T. Thundat, G.M. Brown, R.P. Woychik, J.J. Schrick, K.B. Jacobson and T.L. Ferrell 1088

Tip-radius-induced artifacts in AFM images of protamine-complexed DNA fibers
M.J. Allen, N.V. Hud, M. Balooch, R.J. Tench, W.J. Siekhaus and R. Balhorn 1095

Imaging isolated strands of DNA molecules by atomic force microscopy
T. Thundat, D.P. Allison, R.J. Warmack and T.L. Ferrell 1101

Visualization of the algal polysaccharide carrageenan by scanning tunnelling microscopy
I. Lee, E.D.T. Atkins and M.J. Miles 1107

Atomic force microscopy imaging of T4 bacteriophages on silicon substrates
W.F. Kolbe, D.F. Ogletree and M.B. Salmeron 1113

Ambient-pressure scanning probe microscopy of 2D regular protein arrays
F. Schabert, A. Hefti, K. Goldie, A. Stemmer, A. Engel, E. Meyer, R. Overney and H.-J. Güntherodt 1118

Streptavidin binding observed with an atomic force microscope
A.L. Weisenhorn, F.-J. Schmitt, W. Knoll and P.K. Hansma 1125

Na,K-ATPase in crystalline form investigated by scanning force microscopy
H.-J. Apell, J. Colchero, A. Linder, O. Marti and J. Mlynek 1133

Surface structure of polymers and their model compounds observed by atomic force microscopy
W. Stocker, B. Bickmann, S.N. Magonov, H.-J. Cantow, B. Lotz, J.-C. Wittmann and M. Möller 1141

Molecular-resolution images of aspirin crystals with atomic force microscopy
N. Masaki, K. Machida, H. Kado, K. Yokoyama and T. Tohda 1148

Morphological difference between fibronectin sprayed on mica and on PMMA
R. Emch, F. Zenhausern, M. Jobin, M. Taborelli and P. Descouts 1155

In situ investigations of single living cells infected by viruses
W. Häberle, J.K.H. Hörber, F. Ohnesorge, D.P.E. Smith and G. Binnig 1161

Scanning force microscopy and cryo-electron microscopy of tobacco mosaic virus as a test specimen
F. Zenhausern, M. Adrian, R. Emch, M. Taborelli, M. Jobin and P. Descouts 1168

Electrodeposition procedure of *E. coli* RNA polymerase onto gold and deposition of *E. coli* RNA polymerase onto mica for observation with scanning force microscopy
R.W. Keller, D.J. Keller, D. Bear, J. Vesenka and C. Bustamante 1173

Investigation of dialysis membranes with atomic force microscopy
K. Kasper, K.-H. Herrmann, P. Dietz, P.K. Hansma, O. Inacker, H.-D. Lehmann and Th. Rintelen 1181

Is it possible to observe biological macromolecules by electrostatic force microscopy?
F. Bergasa and J.J. Sáenz 1189

Imaging of proteins by scanning tunnelling microscopy
T.N.C. Wells, M. Stedman and R.J. Leatherbarrow 1200

Molecular images of cereal proteins by STM
N.H. Thomson, M.J. Miles, A.S. Tatham and P.R. Shewry 1204

AFM and STM studies of the interaction of antibodies with the S-layer sheath of the archaeobacterium *Methanospirillum hungatei*
P.J. Mulhern, B.L. Blackford, M.H. Jericho, G. Southam and T.J. Beveridge 1214

Scanning tunneling microscopy of unbroken chloroplasts
D.C. Dahn, K. Cake and L.R. Hale 1222

STM/STS study of photosynthetic bacterial membrane
A.O. Golubok, S.A. Vinogradova, S.Y. Tipisev, A.Y. Borisov, A.S. Taisova and O.V. Kolomytkin 1228

Scanning force microscopy studies of the S-layers from *Bacillus coagulans* E38-66, *Bacillus sphaericus* CCM2177 and of an antibody binding process
F. Ohnesorge, W.M. Heckl, W. Häberle, D. Pum, M. Sara, H. Schindler, K. Schilcher, A. Kiener, D.P.E. Smith, U.B. Sleytr and G. Binnig 1236

Substrate preparation for reliable imaging of DNA molecules with the scanning force microscope
J. Vesenka, M. Guthold, C.L. Tang, D. Keller, E. Delaine and C. Bustamante 1243

Deposition and imaging of metal-coated biomolecules with the STM
R. García, J. Yuqiu, E. Schabtach and C. Bustamante 1250

Reduction by ion-milling of surface corrugation of thin amorphous carbon films for biological specimen substrates in scanning tunneling microscopy
A. Hillebrand, T. Scheybani, W. Wiegräbe and R. Guckenberger 1255

Molecular structures of lipid monolayers on ITO glass and on graphite imaged by an STM
H.D. Göbel, J.K.H. Hörber, Ch. Gerber, A. Leitner and T.W. Hänsch 1260

MISCELLANEOUS APPLICATIONS

Applications of magnetic force microscopy in magnetic storage device manufacturing
G. Persch and H. Strecker 1269

Scanning tunneling microscopy on molecular-beam-epitaxy-grown GaAs(001) surfaces
M. Tanimoto, J. Osaka, T. Takigami, S. Hirono and K. Kanisawa 1275

Effect of Si doping on surface ordering of MBE GaAs(001)
M.D. Pashley and K.W. Haberern 1281

Imaging of passivated III–V semiconductor surfaces by a scanning tunneling microscope operating in air
J.A. Dagata, W. Tseng, J. Bennett, J. Schneir and H.H. Harary 1288

Investigating atomic-scale structures generated with the STM
H. Fuchs, Th. Schimmel, M. Lux-Steiner and E. Bucher 1295

Parallel fabrication on chemically etched silicon using scanning tunneling microscopy
X. Zheng, J. Hetrick, S.-T. Yau and M.H. Nayfeh 1303

High-resolution lithography with a vacuum STM
C.R.K. Marrian and E.A. Dobisz 1309

Topographic study of thin gold films grown on SiO_2
L. Stockman, H. Vloeberghs, I. Heyvaert, C. Van Haesendonck and Y. Bruynseraede 1317

Measuring the fractal dimension with STM: application to vacuum-evaporated gold
J.M. Gómez-Rodríguez, A. Asenjo, R.C. Salvarezza and A.M. Baró 1321

Study of the surface roughness of Co-based amorphous alloys by STM
M. Aguilar, M. Pancorbo, F. Vázquez, F. Gómez, E. Anguiano, J.M. Gonzáles, M. Vázquez and F. Cebollada 1329

Investigation of 10.6 micrometer laser-induced damage on Cu mirrors and Au-coated mirrors (Cu substrate) with STM
Y. Jin, J.Q. Qian, J. Wei, J.E. Yao, Sh.M. Liu, X.L. Yang, X.W. Wang, Zh. Wang, W.Sh. Ma, G.Y. Shang and J. He 1340

Scanning tunneling microscopy of surface modifications induced by UNILAC heavy-ion irradiation
H. Kemmer, S. Grafström, M. Neitzert, M. Wörtge, R. Neumann, C. Trautmann, J. Vetter and N. Angert 1345

Behavior of small metal clusters on solid crystal surfaces
Z. Ma, C. Zhu, J. Shen and S. Pang 1350

Scanning tunneling microscopy investigation of small palladium catalyst particles supported on graphite
L. Porte, M. Phaner, C. Noupa, B. Tardy and J.C. Bertolini 1355

Atomic rearrangement of the SiO_2-stripped Si(001) surface by thermal annealing
M. Niwa, Y. Watanabe, I. Sumita and H. Iwasaki 1360

Imaging polycrystalline CVD diamond films on the micrometer and nanometer scale by STM and AFM
W. Zimmermann-Edling, H.-G. Busmann, H. Sprang and I.V. Hertel 1366

AFM/STM investigation of polycrystalline Si surface
Y. Sugawara, Y. Fukano, Y. Kamihara, S. Morita, A. Nakano, T. Ida and R. Kaneko 1372

Topography of sputtered Si(100) surfaces studied by STM in air
G. Gottschalk, Th. Fries, C. Becker and K. Wandelt 1376

Three-dimensional impurity profiling using chemical etching and scanning tunneling microscopy
M. Tanimoto and T. Takigami 1381

AFM images of dissolution and growth on a calcite crystal
P.E. Hillner, S. Manne, A.J. Gratz and P.K. Hansma 1387

STM studies of uncovered SiO_2 nanometer-particles
J. Hu, M. Gu, L. Zhang, Y. Xu, X. Yao, Z. Wang, Z. Huang, M. Li, Y. Gu, Y. Ge, Y. Li and Z. Wang 1394

STM on doped and undoped hydrogenated amorphous and microcrystalline silicon films
W. Zimmermann-Edling, R. Wiesendanger, F. Finger, K. Prasad and A. Shah 1398

Problems of roughness measurements using STM
R. Hiesgen and D. Meissner 1403

STM on cracks in brittle materials
M. Müller, H. Vehoff and P. Neumann 1412

Scanning tunneling microscopy study of surface relief induced by the tetragonal-to-monoclinic transformation in a zirconia–yttria alloy
M. Yamamoto, T. Fujisawa, T. Saburi, M. Hayakawa, M. Oka, T. Kurumizawa and K. Kusao 1422

Atomic force microscopy of ultrafine clay particles
J. Garnaes, H. Lindgreen, P.L. Hansen, S.A.C. Gould and P.K. Hansma 1428

Sample preparation for STM imaging of silicon at atmospheric pressure
S. Bumgarner and P.E. Russell 1433

Four-probe resistance measurements of nickel wires written with a scanning tunneling microscope/scanning electron microscope system
E.E. Ehrichs, W.F. Smith and A.L. de Lozanne 1438

Nanometer-scale fabrication on graphite surfaces by scanning tunneling microscopy
K. Uesugi and T. Yao 1443

The atomic force microscope used as a powerful tool for machining surfaces
T.A. Jung, A. Moser, H.J. Hug, D. Brodbeck, R. Hofer, H.R. Hidber and U.D. Schwarz 1446

Material transfer between metallic tips and surface in the STM
C.X. Guo and D.J. Thomson 1452

Method for the experimental investigation of tip profiles for scanning tunneling microscopy
V.V. Efremov, P.N. Louskinovich and V.I. Nikishin 1459

Force measurement with a piezoelectric cantilever in a scanning force microscope
J. Tansock and C.C. Williams 1464

Design and operation of a low-temperature scanning tunneling microscope suitable for operation below 1 K
P. Davidsson, H. Olin, M. Persson and S. Pehrson 1470

Micromachined silicon cantilevers and tips for bidirectional force microscopy
R.A. Buser, J. Brugger and N.F. de Rooij 1476

Sharp, vertical-walled tips for SFM imaging of steep or soft samples
D. Keller, D. Deputy, A. Alduino and K. Luo 1481

Imaging of low-load indentations into Si and GaAs by scanning tunneling microscopy
M.R. Castell, M.G. Walls and A. Howie 1490

A stand-alone scanning force and friction microscope
M. Hipp, H. Bielefeldt, J. Colchero, O. Marti and J. Mlynek 1498

Rocking-beam force-balance approach to atomic force microscopy
D.A. Grigg, P.E. Russell and J.E. Griffith 1504

A theoretical comparison between interferometric and optical beam deflection technique for the measurement of cantilever displacement in AFM
C.A.J. Putman, B.G. de Grooth, N.F. van Hulst and J. Greve 1509

Preparation and characterization of tips for scanning tunneling microscopy of biological specimens
B. Hacker, A. Hillebrand, T. Hartmann and R. Guckenberger 1514

Tips for scanning tunneling microscopy produced by electron-beam-induced deposition
B. Hübner, H.W.P. Koops, H. Pagnia, N. Sotnik, J. Urban and M. Weber 1519

Microfabrication of AFM tips using focused ion and electron beam techniques
H. Ximen and P.E. Russell 1526

A computer-controlled technique for electrochemical STM tip fabrication
R. Fainchtein and P.R. Zarriello 1533

Field emission current–voltage curves as a diagnostic for scanning tunneling microscope tips
J.A. Meyer, S.J. Stranick, J.B. Wang and P.S. Weiss 1538

Atomic force microscope coupled with an optical microscope
R. Kaneko, S. Oguchi, S. Hara, R. Matsuda, T. Okada, H. Ogawa and Y. Nakamura 1542

Atomic force microscope featuring an integrated optical microscope
C.A.J. Putman, K.O. van der Werf, B.G. de Grooth, N.F. van Hulst, F.B. Segerink and J. Greve 1549

Scanning tunneling microscope coaxially arranged with an optical microscope
M. Suzuki, T. Fujii, T. Onuki, M. Miyashita and M. Matsushiro 1553

STM combined with SEM without SEM capability limitations
A.O. Golubok and V.A. Timofeev 1558

Integration of an STM in an SEM
M. Troyon, H.N. Lei and A. Bourhettar 1564

A compact STM compatible with conventional SEM
K. Nakamoto and K. Uozumi 1569

Thermofield tip formation in UHV/STM combined field emission microscope
A.O. Golubok, S.A. Masalov and N.A. Tarasov 1574

Scan control and data acquisition for bidirectional force microscopy
D. Brodbeck, L. Howald, R. Lüthi, E. Meyer and R. Overney 1580

Restoration of STM images distorted by time-dependent piezo driver aftereffects
E.P. Stoll 1585

AFM and STM activities at Advanced Technologies Center
Yu.N. Moiseev, V.I. Panov, S.V. Savinov, S.I. Vasil'ev and I.V. Yaminsky 1596

Scanning tunneling microscope with large scan range
V.K. Adamchuk, A.V. Ermakov and S.I. Fedoseenko 1602

Device for high resolution positioning
R. Carr and R.E. Thomson 1606

Analysis of vibration-isolating systems for scanning tunneling microscopes
M. Schmid and P. Varga 1610

Probe characterization for scanning probe metrology
D.A. Grigg, P.E. Russell, J.E. Griffith, M.J. Vasile and E.A. Fitzgerald 1616

Low-temperature ultra-high-vacuum scanning tunneling microscope
R. Gaisch, J.K. Gimzewski, B. Reihl, R.R. Schlittler, M. Tschudy and W.D. Schneider 1621

Construction of a low-temperature STM with in situ sample cleavage
H. Bando, H. Tokumoto, A. Zettl and K. Kajimura 1627

A low-temperature scanning tunneling microscope with in-situ sample cleaving
A.D. Kent, Ch. Renner, Ph. Niedermann, J.-G. Bosch and Ø. Fischer 1632

Low-temperature force microscope with all-fiber interferometer
T.R. Albrecht, P. Grütter, D. Rugar and D.P.E. Smith 1638

Low-temperature compatible *I–V* converter
B. Michel, L. Novotny and U. Dürig 1647

In situ testing and calibration of tube piezoelectric scanners
C.J. Chen 1653

A novel ZnO whisker tip for atomic force microscopy
H. Kado, K. Yokoyama and T. Tohda 1659

Improved wide-range bimorph scanners
Š. Lányi and M. Ožvold 1664

Proposal for a new optical device to sense AFM forces
A. Diaspro and M. Aguilar 1668

Bibliography 1671

Author index 1685

Subject index 1703